
मेटीरियल हैंडलिंग रोवेस — रीति संहिता
(दूसरा पुनरीक्षण)

**Material Handling Ropeways —
Code of Practice**
(Second Revision)

ICS 45.100

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Continuous Bulk Conveying, Elevating, Hoisting, Aerial Ropeways and Related Equipment Sectional Committee, had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1997. Substantial changes in the industrial practices necessitates this revision.

An aerial ropeway is a special form of transportation system where passengers/materials are carried on tensioned wire rope supported above the ground. Aerial ropeways are particularly useful in regions where the facility in surmounting natural barriers gives them a great advantage over railways or roads, both of which may need the heavy civil engineering work to secure easy gradient. They are inexpensive to maintain, their power demand is modest and not seriously affected by adverse climatic conditions.

Nothing in this standard is intended to contravene any provisions of the statutory regulations wherever they are in force.

The major changes in this revision are as follows:

- a) Scope has been modified;
- b) Terminology has been modified;
- c) Latest constructional materials as per relevant Indian Standards have been mentioned for construction of material handling ropeways;
- d) Factor of safety for design of ropeway has been defined in this Standard; and
- e) Clause on trestles, carriers, stations and safety requirements has been added in this Standard.

Annex A gives a list of standards which may be used in the design and construction of aerial ropeways. This list, although not exhaustive, includes standards on raw materials like steels, structural sections, equipment, such as motors, wire ropes, bearings, components of aerial ropeways, fasteners, design parameters, etc. This list is also expected to help the user of an aerial ropeway in the procurement of quality product for use during the maintenance of the aerial ropeways.

Composition of the Panel-1 on 'Aerial Ropeways' of MED 06 responsible for the formulation of this standard is given at Annex B.

For the purpose of deciding whether a particular requirement of the standard is complied with the value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

Indian Standard

MATERIAL HANDLING ROPEWAYS — CODE OF PRACTICE

(*Second Revision*)

1 SCOPE

1.1 This Standard covers the design and construction of all types and systems of material handling ropeways, except the cases where goods are transported by passenger ropeways.

1.2 This standard does not apply to ropeways used in agriculture and forestry.

2 REFERENCES

The Standards listed in Annex A contain provisions which, through reference in the text, constitute provisions of this standard. All standards are subject to revision, and parties to make agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards.

3 TERMINOLOGY

For the purpose of this standard, the terminology given in IS 7649 and the following shall apply.

3.1 Ropeway with Automatic Grip — Continuous movement aerial ropeways with automatic grip in which the carrier are automatically coupled to the rope on leaving the station and detached on arrival at the station.

3.2 Line — Route alignment of the ropeway between two terminals.

3.3 Inspecting Authority — Competent authority recognized by the statutory regulations to inspect the aerial ropeways installation and determine its acceptability or otherwise, on the basis of this standard and compliance to prevailing statutory rules and regulations.

4 GENERAL DESIGN REQUIREMENTS

4.1 Guidelines for Design and Construction

4.1.1 Each part of the ropeway equipment shall be designed and constructed in conformity with this standard and also all technical considerations to ensure full and safe working of the ropeway. The quality of the materials to be used for its construction shall be as per the design. All the materials used shall meet

with the requirements laid down in the relevant Indian Standards. A list of relevant Indian Standards is given in Annex A.

4.1.2 On the request of the supervising authorities or of the purchaser, test certificates (from statutory accredited testing lab) shall be supplied by the constructor as regards the characteristics of all material used and essential to the safety of the installation.

4.1.3 All moving parts of the ropeway, which can be dangerous to the operating personnel, shall be suitably guarded or fenced off.

4.1.4 All parts of ropeway that require frequent servicing and maintenance shall have free access.

4.1.5 All parts of the ropeway plant shall be protected against corrosion.

4.1.6 Line sheaves and saddles shall be made of steel.

4.1.7 Maximum and minimum temperatures and weather conditions for a particular ropeway area shall be given due consideration when designing a ropeway.

4.2 Route and Profile of the Ropeway

4.2.1 As a rule, the axis of the line in its plan position shall be straight. However, horizontal deviation of the path of the travel may be permitted as regards supporting trestles provided that:

- a) *For Monocable Ropeways* — Minimum load on a trestle is equal to the weight of the rope on the trestle plus 150 kg and the angle of horizontal deviation does not exceed 0.5 degree (0.9 percent). This effect shall not be cumulative.
- b) *For Bicable Ropeways* — Deviation of up to 1.14 degree (two percent) per support may be permitted provided the supports are located in a very gentle arc having a minimum radius of 5.0 m.

4.2.2 For bicable installation, the minimum angle of vertical deflection of rope over a line trestle, with the maximum tension in the rope and the rope only condition, shall not be less than 1 percent when the sum of the two adjacent spans is equal to or less than 200 metres, and not less than 1.25 percent when the sum of the spans is greater than 200 metres.

4.2.3 The maximum angle of rope deflection over a line trestle shall not exceed the values for which the saddles and line-sheaves batteries have been designed.

4.2.4 If the Length of a ropeway is too long, it may be divided in multiple sections having independent Drive, and in the case of a bi-cable rope way track rope divide stations are considered.

4.2.5 The length between track rope divide-tension stations is determined by the cumulative tension due to the difference of levels and the friction resistance force on the saddles and also transportation and handling aspects. The rope friction can be taken into account with a friction coefficient of 0.10.

The increase in tension should not be greater than 25 percent of the tension weight load.

4.2.6 Length of the hauling rope section shall be decided on the basis of the actual design requirements based on system capacity, terrain, workability etc., provided that using standard criteria, different safety aspect of the hauling rope lay down in appropriate standards are adhered to.

4.2.7 In cases, when the straight line profile crosses too many obstacles in the form of built-up areas, roads, rivers, densely inhabited area etc., an alternative straight route or a route with angle stations should be considered.

4.2.8 All crossing points of roads, railways and power lines etc., shall be discussed and agreed upon by the purchaser and appropriate authorities. Crossings should be protected by bridges or protection nets (*see 4.5*).

4.2.9 The carriers must be capable of passing over the trestles even in presence of inward and outward oscillation of 12° with minimum 0.25 m clearance without contact with tower structure.

4.2.10 In order to ensure free movement of carriers in the station, the side clearance between the space occupied by the carrier and fixed obstacles belonging to the installation shall be not less than 0.20 m measured towards the interior of the line and 1 m measured towards the outside. If the carrier are not guided, these values shall be maintained even when the carrier is inclined transversely at 12°.

4.2.11 Along the line, the distance between the two paths of travel of the rope (track width), shall be such as to ensure a clearance of at least 0.4 m between carrier swung by 12° towards one another. Such clearance is required for spans having a length of not more than 200 m. As for longer spans, the clearance shall be increased by 0.10 m for each additional 100 m or fraction thereof.

4.2.12 A minimum clearance of 30 cm between the space occupied by a loaded carrier, swung longitudinally by 15° and obstacles lying on the vertical longitudinal plane, shall be ensured either along the line or in the stations.

4.2.13 The minimum vertical clearance, that is, the distance between the ground with obstacles existing over it, such as trees, rocks, snow drifts etc. and the lowest moving portion of a ropeway (bottom of the bucket or haulage rope) (*also see 4.5.2.2*) shall be as given below, under the most unfavorable conditions or assuming a conventional increase of 20 percent of the amount of static sag, shall be not less than:

a) Over National highways	6.0m
b) Over other vehicular roads	4.5m
c) Over footpaths frequented by pedestrians	2.5m
d) Over areas where traffic is not allowed to pass	1.5 m

The minimum clearances are normally not available at entry and exit points of the carriers from the stations. Such places shall be cordoned off by fencing.

4.2.14 In case of crossings with overhead electric lines, railway lines, navigational passage, net clearance shall be as specified in respective statutory provisions. These clearances shall be under the most unfavorable conditions.

4.3 Maximum Speed and Minimum Spacing Between Carriers

4.3.1 The maximum speed adopted for the system shall be consistent with safe working of all mechanical elements and shall not induce abnormal loads in the rope or any other part of the system.

In no case shall the maximum speed exceed the values given below:

a) Continuously circulating bicable ropeways	- 5.0 m/sec
b) To-and-fro bicable ropeways	- 8.0 m/sec
c) Continuously circulating monocable ropeways	- 4.5 m/sec
d) To-and-fro monocable ropeways	- 6.0 m/sec

The drive shall also be capable of running the system at inspection speed, that is, 0.3-0.5 m/s and traversing the carrier a full cycle.

4.3.2 In case the stations are not provided with mechanism for regulating the release of carriers on the line as per designed interval, it shall be ensured that under no circumstances, the distance separating two successive carrier shall be less than 1 m, considering 15° longitudinal swing of two carrier towards each other under the conditions of emergency stopping.

4.4 Rope Guiding

4.4.1 The permanency of the carrying wire rope on the shoes shall be ensured even under the most unfavourable conditions. The minimum load on the shoe shall be at least 50 percent greater than the force which would be necessary to unseat the rope taking into account a gust of wind as per IS 875.

4.4.2 Track rope line saddles shall be such mounted that they are free to oscillate and their shape is such that the carriage pass over them smoothly. The radius of the rope groove on a saddle shall be 10 percent larger than the rope radius. The minimum radius of a saddle shall not be less than 100 times rope diameter or 3 500 mm.

4.4.3 In bicable ropeways with the under type system carriage, provisions shall be made to guide the hauling rope on to the supporting rollers.

4.4.4 The minimum load on a trestle for monocable ropeways shall be equal to the weight of the rope on the trestle plus 150 kg.

4.4.5 On monocable ropeways, all the line sheaves should have ball or roller bearings and all the oscillating mounts shall have bushes of cast iron, bronze, nylon or other suitable material.

4.4.6 On trestles, two sheaves on each side of the line are minimum. Single sheaves are not allowed except for the rope lead on the driving or return sheaves.

4.5 Crossing with Traffic Lines

4.5.1 General

- a) The crossings and paralleling with railways, highways, ropeways or overhead electrical lines shall be so done that no mutual discomfort results either in course of normal operation or during installation operations. Wherever the local conditions are favourable and the characteristics of the electrical line permit it, the overhead electrical lines shall be grounded in conformity with prevalent statutory regulations. If underground cabling is not possible, ropeway shall pass below it.
- b) All heavy traffic lines (railways, roads and industrial areas) shall have protective structures.
- c) All other traffic paths (connecting tracks, field paths, etc.) shall have warning boards.
- d) At the place of crossing with railways, the protective structures shall be designed to offer protection against a falling ropeway carrier. In the case of crossing with roads and industrial areas, the protective structures shall be designed to offer protection against falling material, that is conveyed and falling of the ropes.

- e) The protection bridges shall be made of steel, concrete, wood, guard net or a suitable combination of these. Suitably painted yellow/black stripes warning boards shall be provided on them.

4.5.2 Protection Bridges

4.5.2.1 The surface of the protective bridges shall be located as close as possible to and below the lower edge of ropeway carrier under most unfavorable conditions in case of ropeway passing above the obstruction. In case of ropeway passing under the high tension line the clearance shall be measured from the highest point in the ropeway carriage. The width of the protective bridges shall be such that, even if a side swing of 12 degree occurs, the car and parts that fall from it can be securely caught.

4.5.2.2 Top level of the deck or net shall be such that the moving carriers, even if two numbers are bunched, shall not touch or hit, under the worst conditions of sag, a bucket fallen on its sides (or bucket and hanger) left uncleared on the deck.

4.5.2.3 The clearances under the protective bridges shall be as specified in 4.2.13 and 4.2.14.

4.5.2.4 The load due to dead weight, snow and wind shall be taken in accordance with relevant Indian Standards. A list of relevant Indian Standards is given in Annex A.

4.5.2.5 If a fall of a carrier has to be taken into account, then the non-elastic impact of its heaviest single part (carriage or hanger or bucket together with the conveyed material) shall be taken into account for the calculation of the directly hit supporting structure (covering, transverse beam). If only falling material that is conveyed has to be taken into account, then this shall be done by assuming a static load of 100 kg/m² over the entire bridge.

4.5.2.6 The metal parts of the trestle shall have a factor of safety defined as the ratio of the ultimate strength of the metal to stress in the metal under the most unfavourable conditions of not less than 3.0 when the installation is in service.

4.5.3 Protective or Guard Net

4.5.3.1 The guard net shall be located below the lower edge of the ropeway carrier and as near to it as possible.

4.5.3.2 The guard net shall be supported by 3 or 4 carrying ropes anchored securely at both ends or tensioned by weights on one side.

4.5.3.3 For short nets a series of buffer springs shall be provided in all cases at each of the two, carrying rope ends in order to assure moderate tension increase in the carrying rope if a carrier falls.

4.5.3.4 For binding the carrying rope in the region of the net, steel cross bars shall be located at 3 to 4 m distance.

4.5.3.5 To prevent objects fallen on the net from rolling sideward, the ends of the cross bars shall be bent up by 60° over a length of one meter.

4.5.3.6 The bent up ends of the cross bars shall be connected by a railing rope.

4.5.3.7 Once the lattice is formed of ropes and cross bars, two galvanized steel wire nets shall be placed on it. The first net shall be of steel wires of minimum 3 mm diameter and 3 to 8 cm mesh width. Over this a second net of fine mesh with 1 to 2 cm width, according to the type of material conveyed, shall be placed.

4.5.3.8 The nets shall be fastened with strong galvanized binding wires to the suspension ropes, the railing ropes and the cross bars.

4.5.3.9 The wind and snow load shall be considered in accordance with relevant Indian standards.

4.5.3.10 While considering a falling carrier, the load assumption and the safety factor shall be in accordance with **4.5.2.6**.

4.6 Dangerous Areas

4.6.1 In the proximity of airports or in areas where aeroplanes fly at low altitude or land frequently, the route of the ropeway shall be adequately marked, taking into account any restriction imposed by the Authority having jurisdiction over the airports.

4.6.2 The areas exposed to the dangers of natural forces (avalanches, landslides, rock falls, storms, etc.) shall be avoided as far as possible.

4.6.3 When the dangers indicated in **4.6.2** exist, suitable protection devices shall be provided.

4.7 Wind Action

4.7.1 The wind forces and their effects (static and dynamic) shall be taken into account, when designing ropeways. The provisions mentioned in IS 875 (Part 3) and in IS 802 (Part 1) shall be followed.

4.7.2 In the calculation of wind action on cables, the surface area to be considered shall be the

diametral surface of the cable multiplied by the factor (C_w):

- a) $C_w \approx 1.1$ for snow bound areas; and
- b) $C_w \approx 0.7$ for areas not affected by snow.

4.7.3 The uplift caused by breeze/wind on wire rope and carrier considered along with the conditions specified in **4.4** shall be fully met.

5 ROPES

5.1 Construction

Rope construction shall be such selected which is best suited for its intended function. For track ropes of bicableropeway, ropes of full or half-locked coil construction is recommended. For hauling and carrying-hauling ropes, it shall be of the stranded construction having a fibre core or plastic core, Lang's lay. Tensioning ropes shall be of the ordinary lay (crossed lay) stranded construction.

Ropes and connecting equipment shall conform to the relevant Indian standards. A list of such Indian standards is given in Annex A.

5.2 Factor of Safety

At maximum load during service, the factor of safety, that is, the ratio of minimum breaking load of rope and the maximum rope tension in service shall not be less than the following values:

Carrying rope (bicable)	3.0
Hauling rope for both monocable and bicable	4.5
Tension rope for bicable and monocable	5.0
Signalling and telephonic cables	3.3

5.3 Splices and Rope Termination

5.3.1 For track ropes, the ends shall be connected by means of coupling sockets with wedges or filled-in with alloy material.

The ends of the tensioning ropes shall be mounted in sockets filled-in with alloy material, however, on small capacity ropeways fixing with bull dog clamps shall be allowed.

5.3.1.1 Haulage or carrying

Hauling rope shall be spliced over a length not less than 1 200 times and the distance between two splices shall be not less than 3 000 times the diameter of the rope.

5.3.2 Splicing and rope socketing shall be done with utmost care. Only organization or person having adequate experience in splicing and rope sockets shall be entrusted with the job.

5.4 Discard Criteria of Ropes

Generally a rope should be withdrawn from service when it is considered that:

- a) for track ropes, if the diametrical cross-section is reduced by 15 percent or more due to wear or corrosion or loosening of wires over a length of

200 times the diameter of rope. It shall also be discarded, if, over a length of 1.0 m there are more than 5 outer wire breakages;

- b) the loss of strength in the rope due to fatigue, surface embrittlement or cracked and broken wires of any kind is 20 percent or more or if the factor of safety has decreased by 15 percent of the value when the rope was first installed, or if one of the strands is completely severed;
- c) the outer wires have lost about one-third of their depth as a result of any kind of deterioration;
- d) the outer wires are becoming loose and displaced for any reason;
- e) the rope has become kinked, distorted or damaged and the damaged piece cannot be removed;
- f) examination of the rope leaves any doubt as to its safety for any reason what-so-ever; and
- g) the number of wires rupture in the rope exceed the limit specified in 8.1.6 of IS 3973.

6 LOADS ON SHEAVES, DRUMS AND SADDLES

6.1 Normal Load

6.1.1 The number of carriage rollers shall be such that the maximum load on any one of them does not exceed one-eightieth of the minimum tension for the carrying rope at the point considered. It is recommended that a ratio between the normal load in the cable produced by the carrier and the minimum tension of the carrying cable not exceeding one-twelfth this adopted.

6.1.2 For normal loads in moving wire ropes, the requirements of 4.4 shall be taken into account.

6.1.3 *Sheaves, Drums and Shoe*

The fixed drum to which the anchorage of carrying ropes are secured by friction shall have a diameter of not less than 65 times that of the wire rope and 1 000 times that of the outer wires of the wire ropes. The wire rope shall make at least three rounds of the drum and it should be served at least by two fasteners at the outlet, of which one assures the proper fixation and the second serves to check the slip of the wire rope, if any, and functions as the safety device.

6.1.3.1 The diameter of the pulleys of the tensioning devices to which the carrying ropes fixed directly to the counter weights shall be at least 100 times that of the wire rope.

6.1.3.2 The radius of the roller and returns for tensioning the wire ropes fixed directly to the counter weights shall be not less than 100 times that of the wire ropes and 1 200 times that of the wires of the wire ropes.

6.1.3.3 The diameter of deflection pulleys of stranded stretch wire rope shall be not less than 40 times that of the wire rope and at least 600 times that of the wire in the outer layer of the wire rope. These pulleys shall be provided with linings in leather, wood or any other relatively soft material.

6.1.3.4 The diameter of the driving and return sheaves shall be not less than 80 times that of the hauling rope and at least 800 times that of the wires of the wire rope.

6.1.3.5 The support saddles which support the carrying rope shall present such a profile that while passing the trestles any danger or sliding of carrier is avoided. They have to ensure the equilibrium tension in the wire rope and to permit free displacement of the wire rope in the longitudinal direction when necessary, by making use of the rollers. The radius of curvature of saddle supports shall be at least 100 times that of the wire rope diameter.

7 TRESTLES

7.1 Loads

In designing trestles, the following stress values shall be taken into account:

- a) The weight of the trestle and the pressure exerted by the ropes;
- b) The whole of the stresses due to friction met with during the motion of the moving ropes and during the displacement of a stationary rope;
- c) Weight of the carrier travelling with maximum load (considered conventionally static load);
- d) Wind load or snow load; and
- e) Load imposed by communication cable, if provided.

7.1.1 The wind forces and their effects (static and dynamic) should be taken into account when designing trestles. The provisions mentioned in IS 875 (Part 3), IS 802 (Part 1) shall be followed. Further, loads due to snow in accordance with IS 875 (Part 4) shall also be considered. The design shall also consider seismic loads in accordance with IS 1893. In addition, other special loads in accordance with IS 875 (Part 5) shall also be considered.

7.2 Safety

7.2.1 The metal parts of the trestle shall have a safety factor defined as the ratio of the ultimate strength of the metal to stress in the metal under the most unfavourable conditions of not less than 2.0 when the installation is in service.

7.2.2 The trestle shall be analyzed and designed for various load combinations as per IS 802. The trestle

foundation shall be either a shallow foundation or deep foundation or founded on rock anchors.

7.2.3 The elastic deformation of the trestles, in particular those due to torsion which happens during normal conditions of operation, shall not be, such as to endanger the stability of the ropes. The maximum angle of deformation due to torsion shall be limited in such a manner that the ends of the shoes for supporting the carrying-hauling rope are not displaced by more than 20 percent of the wire rope diameter.

7.3 Construction

7.3.1 The number of trestles, their position, their height and their construction are determined by the requirements of the route and the layout. Wooden trestles or trestles which are guyed shall not be used.

7.3.2 In case the trestles have metallic framework, the thickness of the open profile shape shall not be less than 5 mm while in the case of closed profile, it shall not be less than 2.5 mm. The interior of the latter shall be adequately protected against corrosion.

7.3.3 The anchorage of the trestles on the concrete foundations or on the rock shall be carefully made. The anchor bolts of concrete foundations shall just be at least 300 mm above natural ground level.

8 CARRIER

8.1 Carriages

- a) The carriers shall be so designed that safe transport of material is ensured.
- b) The carriage wheel load shall include the maximum clip pressure due to the haulage rope arising out of maximum break over angle of haulage rope at grip, on the line.
- c) Prevention of any accidental unlocking of carriage grip shall be ensured. It shall also be ensured that the rope is gripped efficiently even if the rope diameter is reduced by 15 percent.
- d) At maximum slope of the ropeway, under the most unfavourable friction conditions, a minimum safety factor of 1.5 shall be maintained against slippage between the hauling rope and the grip. If only one grip is used for attaching the carrier to the carrying-hauling rope, it shall be capable of offering resistance to sliding at least equal to twice the component of the loaded carrier weighed along the axis of the wire rope and the maximum slope and in no case, this resistance to sliding be less than that of the loaded carrier.
- e) For monocable ropeway, the form of the grip and the profile of the grooves of the trestle roller shall be adapted to one another, taking into account specially the maximum lateral swing permitted for

the carrier. As also the carriers pass over the trestle sheaves without bumping.

- f) For fixed-grip systems (Jig-back ropeways), it must be possible for the grips to be easily shifted periodically.
- g) The carrier shall be suspended in such a manner that whatever be the slope of the track, the bucket remains suspended in the vertical position.

8.2 Inspection and Lubrication Car

It is recommended that each bi-cable ropeway is equipped with an inspection car for line inspection and a lubricating car for the track rope lubrication

8.3 Numbering

In order to distinguish the carriers on the line, they shall be successively numbered.

9 STATIONS

9.1 General

9.1.1 Station layouts shall be such that their intended function like loading, unloading, parking, maintenance can be effectively and safely carried out.

9.1.2 The station machinery, such as mechanical parts of the driving gear, tension gear, electrical equipment, ropes and carriers shall not be a source of danger to the rope way operators and trespassers.

9.1.3 Engine room, operator's desk, electrical equipment, tension device etc. shall be guarded against entry /access by unauthorized personnel.

9.1.4 The whole of the driving gear and of the return or deflection devices shall be protected against bad weather.

9.1.5 Fire hazard shall be reduced as far as possible. Fire extinguishers as per local area regulations guaranteed to function effectively shall be kept ready in case of need and installed in places which are readily accessible.

9.1.6 For the calculation of the station structure the provisions of the relevant Indian Standards as applicable to industrial buildings shall be applicable in addition to those required for ropeway.

9.1.7 For calculating the load for the bearing structure of the overhead shunt rails and for the rails themselves, it shall be assumed that fully loaded carriages are one behind the other.

9.2 Driving and Braking

9.2.1 Starting of the system even under the most unfavourable conditions of load shall be guaranteed.

9.2.2 In the case of downward load, the driver itself shall exert a continuous braking action.

9.2.3 Travel with the main motor shall be stopped automatically when any brake is on or if any safety device operates.

9.2.4 Rope Adhesion on the Driving Sheave

9.2.4.1 The friction coefficient (μ) between the rope and the surface of the groove of the driving sheave are as follows:

- | | |
|---|----------------|
| a) Groove without lining
(cast iron or steel) | : $\mu = 0.07$ |
| b) Groove with leather lining | : $\mu = 0.15$ |
| c) Groove with rubber or similar
material with high friction coefficient | : $\mu = 0.25$ |
| d) Groove with aluminum lining | : $\mu = 0.20$ |

9.2.4.2 The contact angle of the rope on the driving sheave shall be such as to ensure that in the most unfavourable combination of circumstances the required power is transmitted to the rope. In cases, when drive power is very high, Karlik grip type gripping sheave may be used.

9.2.5 Braking

9.2.5.1 Each drive shall be equipped with two brakes acting independently of each other. One of these shall be automatic with provision for manual release. One brake shall act directly on the driving sheave. It can be a handbrake provided the other brake, acting on gearbox input shaft, is automatic. Jig-back ropeways and installation which stops on its own without the application of any external brake, can have only one brake but it should act automatically when the ropeway stops.

9.2.5.2 The factor of safety against required braking power shall be not less than 1.5.

9.3 Rope Tensioning and Anchorage Devices

9.3.1 Hauling ropes and carrying-hauling ropes shall be tensioned by tension weight or other suitable tensioning devices. Tension in track ropes shall be provided by tension weight.

9.3.2 The spaces in which the counterweights travel (in pit or construction above the ground) shall be protected from water, snow, and ice and from any other material. It shall be ensured that the above elements do not accumulate inside these spaces. These spaces shall be provided with guard-rails in order to prevent the entrance of unauthorized persons.

9.3.3 The mobility of the counter weights shall be ensured at all times.

9.3.4 The travel of the counterweight shall be determined taking into account the maximum variation which may be due to the sag of each span, the surrounding temperature of the zone where the

installation lies (minimum variation to be considered is 60°) and the elastic stretch of the rope. The distance of travel for tension weights and tension trolley shall be limited by stops. Provision of limit switches may be there to stop the system automatically in the event they reach their extreme position.

9.3.5 The tension weights shall have guides to arrest swinging and twisting of weight block.

9.3.6 In cases when track ropes are fixed by anchorage's on both ends, provision must be made for measuring and regulation of the tension in the rope.

9.3.7 Where several tensioning ropes are laid in parallel, all the necessary precautions shall be taken in order to ensure uniform distribution of the tension among such ropes.

9.3.8 In place of tension ropes, chains can be used. The safety factor shall be at least 5 in this case. Other systems are permissible subject to agreement between the ropeway promoter and the inspecting authority.

9.3.9 The foundations of either tensioning devices or anchorage shall have a factor of safety of 1.5 in respect of shifting and over turning. Such factor of safety is to be calculated on the basis of a conventional assumption that these foundations are free, that is, there is no lateral movement of the earth.

9.3.10 All foundations shall be in accordance with relevant Indian Standards listed in Annex A.

10 SAFETY REQUIREMENT

10.1 Emergency stop buttons shall be provided at suitable location at all stations. Re-starting shall be allowed only after removing the fault.

10.2 Automatic Stopping of the ropeway shall be ensured in the event of any of the following:

- supply voltage drops below the minimum specified,
- supply voltage increases above the maximum specified,
- designed speed of ropeway is exceeds by 10 percent, and
- one of the safety switches is activated.

10.3 System with detachable grip shall have suitable bucket spacing arrangement before leaving the station.

10.4 Jig-back ropeways shall be equipped with limit stops and buffers that will stop the system in the case when the distance of travel is exceeded.

10.5 Ropeways shall be provided with dedicated telephone installation between the stations. Portable telephones or wireless sets shall be available with line inspecting team.

ANNEX A

(Foreword, Clauses 2, 4.1.1, 4.5.2.4, 5.1 and 9.3.10)

LIST OF INDIAN STANDARDS RELATED TO AERIAL ROPEWAY

A-1 STANDARDS FOR RAW MATERIALS		IS No.	Title
A-1.1 Aluminium and Aluminium Alloys		1030 : 1998	Carbon steel casting for general engineering purposes (<i>fourth revision</i>)
IS No.	Title		
617 : 1994	Aluminium and aluminium alloy ingots and castings ~ for general engineering purposes (<i>third revision</i>)	1161 : 2014	Steel tubes for structural purposes (<i>third revision</i>)
		1239	Mild steel tubes, tubular and other wrought steel fittings
733 : 1983	Wrought aluminium and aluminium alloy bars, rods, and sections for general engineering purposes (<i>third revision</i>)	(Part 1) : 2004	Mild steel tubes (<i>fifth revision</i>)
		(Part 2) : 2011	Mild steel tubes and other wrought steel pipe fittings (<i>fourth revision</i>)
738 : 1994	Wrought aluminium alloy drawn tube for general engineering purposes (<i>second revision</i>)	1570	Schedules for wrought steels for general engineering purposes
		(Part 1) : 1978	Steel specified by tensile and/or yield properties (<i>first revision</i>)
2525 : 1982	Dimensions for wrought aluminium and aluminium alloys wire (<i>first revision</i>)	(Part 2/Sec 1) : 1979	Carbon steels (unalloyed steels), Section 1 Wrought products (other than wire) with specified chemical composition and related properties (<i>first revision</i>)
2678 : 1987	Dimensions and tolerances for wrought aluminium and aluminium alloy drawn round tube (<i>second revision</i>)	(Part 2/Sec 2) : 1987	Carbon steels (unalloyed steels), Section 2 Carbon steel wires with related properties (<i>first revision</i>)
3965 : 1981	Dimensions for wrought aluminium and aluminium alloy bar, rod and section (<i>first revision</i>)	(Part 3) : 1979	Carbon and carbon manganese free cutting steels (<i>first revision</i>)
6051 : 1970	Code for designation of aluminium and its alloys	(Part 4) : 1988	Alloy steels (alloy constructional and spring steels) with specified chemical properties (<i>first revision</i>)
6477 : 1983	Dimensions for wrought aluminium and aluminium alloys, extruded hollow section (<i>first revision</i>)	(Part 5) : 1985	Stainless and heat resisting steels (<i>second revision</i>)
		(Part 7) : 1992	Steels for elevated temperature service (creep resistant steels)
A-1.2 Standards for Cast Iron, Cast Steel, Steel and Steel Products		1730 : 1989	Steel plate, sheets, strips and flats for structural and general engineering purposes — Dimensions (<i>second revision</i>)
IS No.	Title		
210 : 2009	Grey iron castings (<i>fourth revision</i>)	1732 : 1989	Dimensions for round and square steel bars or structural and general engineering purposes (<i>first revision</i>)
276 : 2000	Austenitic manganese steel casting (<i>fourth revision</i>)	1852 : 1985	Rolling and cutting tolerances for hot-rolled steel products (<i>fourth revision</i>)
808 : 1989	Dimensions for hot-rolled steel beam, column, channel and angle section (<i>third revision</i>)	1864 : 1979	Hot rolled steel L-sections for shipbuilding (<i>first revision</i>)
811 : 1987	Cold formed light gauge structural steel sections (<i>revised</i>)		

<i>IS No.</i>		<i>Title</i>		A-1.3 Standards for Welding	
				<i>IS No.</i>	<i>Title</i>
1871		Commentary on Indian Standard schedules for wrought steels			
(Part 1) : 1987		Steels specified by tensile and/or yield properties [Complementary to IS 1570 (Part 1) : 1978] (<i>first revision</i>)		812 : 1957	Glossary of terms relating to welding and cutting of metals
(Part 2) : 1987		Carbon steels (unalloyed steels) [Complementary to IS 1570 (Part 2) : 1979] (<i>first revision</i>)		816 : 1969	Code of practice for use of metal are welding for general construction in mild steel(<i>first revision</i>)
(Part 3) : 1987		Carbon and carbon manganese free cutting steels [Complementary to IS 1570 (Part3): 1979] (<i>first revision</i>)		817 : 1966	Code of practice for training and testing of metal are welders (<i>revised</i>)
2049 : 1978		Colour code for the identification of wrought steels for general engineering purposes (<i>first revision</i>)		817 (Part 1) : 1992	Code of practice for training and testing of metal are welders: Part 1 Manual metal are welding (<i>second revision</i>)
2062 : 2011		Steel for general structural purposes (<i>forth revision</i>)		818 : 1968	Code of practice for safety and health requirements in electric and gas welding and cutting operations (<i>first revision</i>)
2644 : 1994		High tensile steel castings for general engineering and structural purposes (<i>fourth revision</i>)		819 : 1957	Code of practice for resistance spot welding for light assemblies in mild steel
2707 : 1996		Carbon steel castings for surface hardening ()		822 : 1970	Code of procedure for inspection of welds
3444 : 1999		Corrosion resistant alloy steel and nickel based castings for general applications (<i>second revision</i>)		1024 : 1979	Code of practice for use of welding in bridges and structures subject to dynamic loading (<i>first revision</i>)
3502 : 2009		Steel chequered plates (<i>third revision</i>)		1179 : 1967	Equipment for eye and face protection during welding (<i>first revision</i>)
3601 : 1984		Steel tubes for mechanical and general engineering purposes (<i>first revision</i>)		1261 : 1959	Code of practice for seam welding in mild steel
3954 : 1991		Hot-rolled steel channel sections for general engineering purposes (<i>first revision</i>)		1323 : 1982	Code of practice for oxy-acetylene welding for structural work in mild steel (<i>second revision</i>)
4899 : 1991		Ferritic and martensitic steel casting for use at low temperatures (<i>second revision</i>)		1393 : 1961	Code of practice for training and testing of oxy-acetylene welders
4923 : 1985		Hollow steel sections for structural use (<i>first revision</i>)		2811 : 1987	Recommendations for manual tungsten inert-gas are-welding of stainless steel (<i>first revision</i>)
8500 : 1991		Structural steel — Microalloyed (medium and high strength qualities) (<i>first revision</i>)		2812 : 1939	Recommendation for manual tungsten inert-gas are-welding of aluminium alloys (<i>first revision</i>)
8800 : 1986		Technical delivery conditions for steel castings (<i>second revision</i>)		3016 : 1982	Code of practice for fire precautions in welding and cutting operations (<i>first revision</i>)
8910 : 1978		General technical delivery requirements for steel and steel products		3600	Methods of testing fusion welded joints and weld metal in steel
14329 : 1995		Malleable iron castings		(Part 1) : 1985	Cruciform fillet weld tensile test (<i>second revision</i>)

<i>IS No.</i>	<i>Title</i>
(Part 2) : 1985	Beam impact (charpy V-notch) test (<i>second revision</i>)
(Part 3) : 1984	Transverse tensile test (<i>second revision</i>)
(Part 4) : 1984	Longitudinal tensile test on cylindrical weld metal test pieces on butt welds (<i>second revision</i>)
(Part 5) : 1983	Transverse root and face bend test on butt welds (<i>second revision</i>)
(Part 6) : 1983	Transverse side bent test on butt welds (<i>second revision</i>)
(Part 7) : 1985	Longitudinal root and face bend test on butt welds (<i>second revision</i>)
(Part 8) : 1985	Nick break test and fillet weld fracture test (<i>second revision</i>)
(Part 9) : 1985	Macro and micro examination (<i>second revision</i>)
3613 : 1974	Acceptance test for wire-flux combination for submerged arc welding (<i>first revision</i>)
4353 : 1995	Submerged-arc welding of mild steel and low alloy steels — Recommendations (<i>first revision</i>)
4943 : 1968	Assessment of butt and fillet fusion welds in steel sheet, plate and pipe
5139 : 1995	Procedure for repair of cast iron castings by oxy-acetylene and manual metal arc welding — Recommendations (<i>first revision</i>)
5530 : 1987	Recommendations for production, rectification and repair of steel casting by metal arc welding process (<i>first revision</i>)
6916 : 1973	Code of practice for fabrication welding of steel casting
7307 (Part 1) : 1974	Approval tests of welding procedures: Part 1 Fusion welding of steel
7310 (Part 1) : 1974	Approval testing of welders working to approval welding procedure: Part 1 Fusion welding of steel
7318	Approval tests for welders when welding procedure approval is not required
(Part 1) : 1974	Fusion welding of steel
(Part 2) : 1974	TIG or MIG welding of aluminium or its alloys
9595 : 1980	Recommendations for metal arc welding of carbon and carbon manganese steels

A-2 STANDARDS FOR DESIGN AND SAFETY

<i>IS No.</i>	<i>Title</i>
800 : 1984	Code of practice for general construction in steel (<i>second revision</i>)
801 : 1975	Code of practice for use of cold formed light gauge steel structural members in general building constructions (<i>first revision</i>)
802	Code of practice for use of structural steel in overhead transmission line towers
(Part 1) : 1977	Loads and permissible stresses (<i>second revision</i>)
(Part 1/Sec 2) : 1992	Material, loads and permissible stresses (<i>second revision</i>)
(Part 2) : 1978	Fabrication, galvanizing, inspection and packing
(Part 3) : 1978	Testing
806 : 1968	Code of practice for use of steel tubes in general building construction (<i>first revision</i>)
807 : 1976	Code of practice for design, manufacture, erection and testing (structural portion) of cranes and hoists (<i>first revision</i>)
4000 : 1992	High strength bolts in steel structures — Code of practice (<i>first revision</i>)
4573 : 1982	Power driven mobile cranes (<i>first revision</i>)
4594 : 1968	Code of practice for design of portal and semi-portal wharf cranes (electrical)
6511 : 1972	Range of preferred safe working loads for cranes, lifting appliances and related excavator equipment

A-3 STANDARDS ON CORROSION PROTECTION

<i>IS No.</i>	<i>Title</i>
3531 : 1983	Glossary of terms relating to corrosion of metals (<i>first revision</i>)
3618 : 1966	Phosphate treatment of iron and steel for protection against corrosion
4180 : 1967	Code of practice for corrosion protection for light gauge steel sections used in building

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
4777 : 1968	Performance tests for protection schemes used in protection of light gauge steel against corrosion	(Part 6) : 1980	Data to be supplied by intending purchaser for aerial system for transportation of forestry products
5555 : 1970	Code of procedure for conducting field studies on atmospheric corrosion of metals	9228 : 1979	Mono seat chairs for chairlifts used in winter sports
6005 : 1970	Code of practice for phosphating of iron and steel	9413 : 1980	Rope guide rollers for haulage ropes of bicable aerial ropeways for transportation of goods
8221 : 1976	Code of practice for corrosion prevention of metal components in packages	9454 : 1980	Bicable load carrier for aerial ropeways
8629	Code of practice for protections or iron and steel structures from atmospheric corrosion	A-4.2 Standards on Wire Ropes and Wire Products	
		<i>IS No.</i>	<i>Title</i>
(Part 1) : 1977	General principles of corrosion and its prevention	1804 : 1982	Fibre cores for steel wire ropes (<i>second revision</i>)
(Part 2) : 1977	Pretreatment	2265 : 1978	Galvanized steel wire strand for signaling purposes (<i>first revision</i>)
(Part 3) : 1977	Protection schemes	2315 : 1978	Thimbles for wire ropes (<i>first revision</i>)
A-4 STANDARDS FOR MECHANICAL COMPONENTS		2361 : 1994	Bulldog grips — Specification (<i>second revision</i>)
A-4.1 Standards on Aerial Ropeways		2363 : 1981	Glossary of terms relating to wire ropes (<i>first revision</i>)
<i>IS No.</i>	<i>Title</i>		
5228 : 1969	Code of practice for construction of continuous movement monocable ropeways with fixed grips intended for transportation of passengers	2485 : 1979	Drop forged sockets for wire ropes for general engineering purposes (<i>first revision</i>)
5229 : 1969	Code of practice for construction of continuous movement monocable ropeways with automatic grips intended for transportation of passengers	3121 : 1981	Rigging screws and stretching screws (<i>first revision</i>)
5230 : 1969	Code of practice for construction of continuous to-and-fro movement bicable ropeways intended for transportation of passengers	3937	Recommendations for socketing of wire ropes
7649 : 1975	Glossary of terms used in connection with aerial ropeways and cableways	(Part 1) : 1974	Socketing with zinc (<i>first revision</i>)
9047	Data sheet for aerial ropeways and cableways	(Part 2) : 1974	Socketing with white metal (<i>first revision</i>)
(Part 1) : 1979	Data to be supplied by intending purchaser for aerial system for transportation of goods	3973 : 1984	Code of practice for the selection, installation and maintenance of wire ropes (<i>first revision</i>)
(Part 2) : 1980	Data to be supplied by intending purchaser for aerial system for transportation of passengers, surface	5245	Method for splicing of wire ropes
		(Part 1) : 1969	Hand splicing of wire ropes
		(Part 2) : 1971	Wire rope sling legs with ferrule secured eye terminals
		6594 : 1977	Technical supply conditions for steel wire ropes and strands (<i>first revision</i>)
		10891	Steel wire ropes for aerial ropeways
		(Part 1) : 1984	Haulage ropes
		(Part 2) : 1986	Track ropes

A-4.3 Standards on Fasteners

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
		(Part 14) : 1984	Stainless steel threaded fasteners (<i>second revision</i>)
549 : 1974	Split pins (<i>second revision</i>)	(Part 16) : 1979	Designation system and symbols (<i>first revision</i>)
1363	Hexagon head bolts, screws and nuts of product grade C	(Part 18) : 1979	Marking and mode of delivery (<i>second revision</i>)
(Part 1) : 1992	Hexagon head bolts (size range M5 to M64) (<i>third revision</i>)	1929 : 1982	Hot forged steel rivets for hot closing (12 to 36 mm diameter) (<i>first revision</i>)
(Part 2) : 1992	Hexagon head screws (size range M5 to M64) (<i>third revision</i>)	2155 : 1982	Cold forged solid steel rivets for hot closing (6 mm to 16 mm diameter) (<i>first revision</i>)
(Part 3) : 1992	Hexagon nuts (size range M5 to M64) (<i>third revision</i>)	2585 : 1968	Black squares bolts and nuts (dia range 6 to 39 mm) (<i>first revision</i>)
1364	Hexagon head bolts, screws and nuts of product grade A and B	2614 : 1969	Methods for sampling of fasteners (<i>first revision</i>)
(Part 1) : 1992	Hexagon head bolts (size range M1.6 to M64) (<i>third revision</i>)	2587 : 1991	Cap nuts — Specification (<i>second revision</i>)
(Part 2) : 1992	Hexagon head screws (size range M1.6 to M64) (<i>third revision</i>)	3063 : 1994	Fastener — Single coil rectangular section spring washers (<i>second revision</i>)
(Part 3) : 1992	Hexagon nuts (size range M1.6 to M64) (<i>third revision</i>)	3138 : 1966	Hexagonal bolts and nuts (M42 to M150)
1367	Technical supply conditions for threaded steel fasteners	3757 : 1985	High strength structural bolts (<i>second revision</i>)
(Part 1) : 1980	Introduction and general information (<i>second revision</i>)	4218	ISO metric screw threads
(Part 2) : 1979	Product grades and tolerances (<i>second revision</i>)	(Part 1) : 1976	Basic and design profiles (<i>first revision</i>)
(Part 3) : 1991	Mechanical properties and test methods for bolts, screws and studs with full loadability (<i>third revision</i>)	(Part 2) : 1976	Diameter pitch combinations (<i>first revision</i>)
(Part 5) : 1980	Mechanical properties and test methods for set screws and similar threaded fasteners not under tensile stresses (<i>second revision</i>)	(Part 3) : 1976	Basic dimensions for design profiles (<i>first revision</i>)
(Part 6) : 1994	Mechanical properties and test methods for nuts with specified proof loads(<i>second revision</i>)	(Part 4) : 1976	Tolerancing system (<i>first revision</i>)
(Part 7) : 1980	Mechanical properties and test methods for nuts without specified proof loads (<i>second revision</i>)	(Part 5) : 1979	Tolerances (<i>first revision</i>)
(Part 8) : 1992	Mechanical and performance properties for prevailing torque type steel hexagon nuts (<i>second revision</i>)	(Part 6) : 1978	Limits of sizes for commercial bolts and nuts (dia range 1 to 52 mm) (<i>first revision</i>)
(Part 9) : 1979	Surface discontinuities on bolts, screws and studs (<i>second revision</i>)	2398 : 1967	Identification code for rolling bearings
(Part 10) : 1979	T Surface discontinuities on nuts (<i>second revision</i>)	3090 : 1965	Code of practice for installation and maintenance of rolling bearings
(Part 12) : 1981	Phosphate coatings on threaded fasteners (<i>second revision</i>)	5669 : 1987	General plan of boundary dimensions for radial rolling bearings (<i>first revision</i>)
(Part 13) : 1983	Hot-dip galvanized coatings on threaded fasteners (<i>second revision</i>)	5932 : 1970	Boundary dimensions for thrust ball bearings with flat seats
		6453 : 1984	Technical supply conditions for rolling bearings (<i>first revision</i>)

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
6454 : 1972	Self aligning roller bearings	(Part 2) : 1967	PVC-insulated and PVC sheathed heavy duty cables
6455 : 1972	Single row radial ball bearings	(Part 3) : 1968	Rubber insulated cables
6456 : 1972	Double row radial ball bearings	(Part 4) : 1968	Polyethylene insulated cables
6457 : 1972	Single row cylindrical roller bearings	(Part 5) : 1968	PVC insulated light duty cables
6458 : 1972	Double row cylindrical roller bearings	4288 : 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages upto and including 1 100 volts (<i>second revision</i>)
7461 (Part 1) : 1993	General plan of boundary dimensions for tapered roller bearings: Part 1 Single row bearings (<i>second revision</i>)	7093 : 1973	Straight through joint boxes and lead sleeves for paper insulated lead-sheathed cables up to and including 11 kV
A-5 STANDARDS ON ELECTRICAL COMPONENTS		9968	Elastomer insulated cables
A-5.1 Standards for Cables		(Part 1) : 1988	For working voltages upto and including 1 100 V (<i>first revision</i>)
<i>IS No.</i>	<i>Title</i>	(Part 2) : 1981	For working voltages from 3.3 kV upto and including 11 kV
282 : 1982	Hard drawn copper conductors for overhead power transmission (<i>second revision</i>)	A-5.2 Standards on Electrical Installations	
398	Aluminium conductors for overhead transmission purposes	<i>IS No.</i>	<i>Title</i>
(Part 1) : 1976	Aluminium stranded conductors (<i>second revision</i>)	732 : 1989	Code of practice for electrical wiring installations (<i>third revision</i>)
(Part 2) : 1976	Aluminium conductors galvanized steel reinforced (<i>second revision</i>)	900 : 1992	Code of practice for installation and maintenance of induction motors (<i>second revision</i>)
(Part 3) : 1976	Aluminium conductors aluminized steel reinforced (<i>second revision</i>)	1944	Code of practice for lighting of public thoroughfare
(Part 4) : 1994	Aluminium alloy stranded conductor (aluminium magnesium silicon types) (<i>third revision</i>)	(Part 1 and 2) : 1970	For main and secondary roads (Group A and B) (<i>first revision</i>)
(Part 5) : 1992	Aluminium conductors — Galvanized steel reinforced for extra high voltage (40 kV and above) (<i>first revision</i>)	(Part 5) : 1981	Lighting for grade separated junctions, bridges and elevated roads (Group D) (<i>first revision</i>)
692 : 1994	Paper insulated lead-sheathed cables for rated voltage up to and including 33 kV (<i>third revision</i>)	(Part 6) : 1981	Lighting for towns and city centers and area of civic importance (Group E) (<i>first revision</i>)
694 : 2010	PVC insulated cables for working voltages up to and including 1100 volts (<i>third revision</i>)	(Part 7) : 1981	Lighting for roads with special requirements (Group F) (<i>first revision</i>)
1255 : 1983	Code of practice for installation and maintenance of power cables up to and including 33 kV rating (<i>second revision</i>)	2309 : 1989	Practice for the protection of building and allied structures against lightning — Code of practice (<i>second revision</i>)
3961	Recommended current ratings for cables	2551 : 1982	Danger notice plates (<i>first revision</i>)
(Part 1) : 1967	Paper-insulated lead-sheathed cables	3043 : 1987	Code of practice for earthing (<i>first revision</i>)

<i>IS No.</i>	<i>Title</i>
5216	Guide for safety procedures and practices in electrical works
(Part 1) : 1982	General (<i>first revision</i>)
(Part 2) : 1982	Life saving techniques (<i>first revision</i>)
8061 : 1976	Code of practice for design, installation and including 650 V

A-5.3 Standards on Illumination

<i>IS No.</i>	<i>Title</i>
418 : 1978	Tungsten filament general service electric lamps (<i>third revision</i>)
897 : 1982	Tungsten filament electric lamps for railways rolling stock (<i>second revision</i>)
1913(Part 1) : 1978	General and safety requirements for luminaries: Part 1 Tubular fluorescent lamps (<i>second revision</i>)
2418	Tubular fluorescent lamps for general lighting service
(Part 1) : 1977	Requirements and test (<i>first revision</i>)
(Part 2) : 1977	Standard lamp data sheets (<i>first revision</i>)
(Part 3) : 1977	Dimensions of G-5 and G-13 bi-pin caps (<i>first revision</i>)
(Part 4) : 1977	Go and no go gauges for G-5 and G-13 bi-pin caps (<i>first revision</i>)
3287 : 1965	Industrial lighting fittings with plastic reflectors
3528 : 1966	Waterproof electric lighting fittings
3553 : 1966	Watertight electric lighting fittings
3646	Code of practice for interior illumination
(Part 1) : 1992	General requirements and recommendations for working interiors (<i>first revision</i>)
(Part 2) : 1966	Schedule for values of illumination and glare index
(Part 3) : 1968	Calculations of coefficients of utilization by the B2 method
4012 : 1967	Dust-proof electric lighting fittings
4013 : 1967	Dust-tight electric lighting fittings
6665 : 1972	Code of practice for industrial lighting
6701 : 1985	Tungsten filament miscellaneous electric lamps (<i>first revision</i>)

A-5.4 Standards on Rotating Machines, Switchgear, Transformers, etc.

<i>IS No.</i>	<i>Title</i>
325 : 1978	Three-phase induction motors (<i>fourth revision</i>)
1231 : 1974	Dimensions of three-phase foot-mounted induction motors (<i>third revision</i>)
2223 : 1983	Dimensions of flange mounted ac induction motors (<i>first revision</i>)
2253 : 1974	Designations for types of construction and mounting arrangements of rotating electrical machines (<i>first revision</i>)
3151 : 1982	Earthing transformers (<i>first revision</i>)
4237 : 1982	General requirements for switchgear and controlgear for voltages not exceeding 1 000 V ac or 1 200 V dc (<i>first revision</i>)
4691 : 1985	Degree of protection provided by enclosures for rotating electrical machinery (<i>first revision</i>)
4722 : 1992	Rotating electrical machines (<i>first revision</i>)
4728 : 1975	Terminal marking and direction of rotation for rotating electrical machinery (<i>first revision</i>)
8223 : 1976	Dimensions and output ratings for foot-mounted rotating electrical machines with frame numbers 355 to 1 000
8789 : 1978	Values of performance characteristics for three-phase induction motors
9320 : 1979	Guide for testing of direct current (dc) machines
10118	Code of practice for selection, installation and maintenance of switchgear and controlgear
(Part 1) : 1982	General
(Part 2) : 1982	Selection
(Part 3) : 1982	Installation
(Part 4) : 1982	Maintenance
13947	Low-voltage switchgear and control gear
(Part 1) : 1993	General rules
(Part 4/Sec 1) : 1993	Contactors and motor starters, Section 1 Electromechanical contactors and motor starters.

A-6 STANDARDS ON BUILDING CONSTRUCTION

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
		1904 : 1986	Code of practice for design and construction of foundations in soils: General requirements (<i>third revision</i>)
456 : 1978	Code of practice for plain and reinforced concrete (<i>third revision</i>)	2440 : 1975	Code of practice for daylighting of buildings (<i>second revision</i>)
875	Code of practice for design loads (other than earthquake) for buildings and structures	2974 (Part 3) : 1992	Design and construction of machine foundations — Code of practice: Part 3 Foundations for rotary type machines (medium and high frequency) (<i>second revision</i>)
(Part 1) : 1987	Deadloads — Unitweights of building material and stored materials (<i>second revision</i>)	2974(Part 4) : 1979	Code of practice for design and construction of machine foundations: Part 4 Foundations for rotary type machines of low frequency (<i>first revision</i>)
(Part 2) : 1987	Imposed loads (<i>second revision</i>)	3103 : 1975	Code of practice for industrial ventilation (<i>first revision</i>)
(Part 3) : 1987	Wind loads (<i>second revision</i>)	3614(Part 1) : 1966	Fire-cheek doors: Part 1 Plate, metal covered and rolling type
(Part 4) : 1987	Snow loads (<i>second revision</i>)	4326 : 1988	Earthquake resistant design and construction of buildings — Code of practice (<i>second revision</i>)
(Part 5) : 1987	Special loads and load combinations (<i>second revision</i>)	4351 : 1976	Steel door frames (<i>first revision</i>)
1038 : 1983	Specification for steel doors. Windows and ventilators (<i>third revision</i>)	4912 : 1978	Safety requirements for floor and wall openings, railings and toe boards (<i>first revision</i>)
1080 : 1995	Code of practice for design and construction of shallow foundation on soil (other than raft, ring and shell) (<i>second revision</i>)	4913 : 1968	Code of practice for selection, installation and maintenance of timber doors and windows
1361 : 1978	Steel windows for industrial buildings (<i>first revision</i>)	5533 : 1969	Recommendation for dimensions of spaces for human activities
1642 : 1989	Code of practice for fire safety of buildings (general): Details of construction (<i>first revision</i>)	6313	Code of practice for anti-termite measures in buildings
1643 : 1988	Code of practice for fire safety of buildings (general): Exposure hazard (<i>first revision</i>)	(Part 1) : 1981	Constructional measures (<i>first revision</i>)
1646 : 1982	Code of practice for fire safety of buildings (general): Electrical installations (<i>first revision</i>)	(Part 2) : 1981	Pre-constructional chemical treatment measures (<i>first revision</i>)
1892 : 1979	Code of practice for subsurface investigations for foundations (<i>first revision</i>)	(Part 3) : 1981	Treatment for existing building (<i>first revision</i>)

ANNEX B

(Foreword)

COMMITTEE COMPOSITION

Composition of the Panel-1 on ‘Aerial Ropeways’ MED 06

<i>Organizations</i>	<i>Representative(s)</i>
In Personal Capacity	SHRI A. BHADRA (<i>Convener</i>)
In Personal Capacity	SHRI C. K. KARMAKAR
In Personal Capacity, Kolkata	SHRI DWIJENDRA LAL DAS (<i>Invitee</i>)
CSIR-CIMFR, Dhanbad	DR DEBASISH BASAK
CRS, Pvt Ltd, Kolkata	SHRI K. BOSE
Damodar Ropeways & Infra Ltd, Kolkata	SHRI RANJAN MUKHERJEE
Usha Breco Limited, Ghaziabad	SHRI MANOJ PANWAR

Member Secretary

SHRI A. K. MOHINDROO
SCIENTIST ‘C’ (MED), BIS

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.gov.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
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Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
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